Ontario Geological Survey

Northern Ontario Engineering Geology Terrain Study 79

MICHIPICOTEN AREA

(NTS 41N/NE and part of 41N/NW)

Districts of Algoma and Sudbury

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by
D.F. McQuay

1980

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Hon. James A.C. Auld
Minister

Dr. J.K. Reynolds
Deputy Minister

Ministry of Northern Affairs

Hon. Leo Bernier
Minister

Art Herridge
Deputy Minister

93-02408/

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THIS PROJECT WAS FUNDED BY
THE ONTARIO MINISTRY OF NORTHERN AFFAIRS
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Orders for publications should be accompanied by cheque or money order payable to the *Treasurer of Ontario.*

ISSN 0709-4671
ISBN 0-7743-4355-9

Parts of this publication may be quoted if credit is given. It is recommended that reference to this report be made in the following form:

McQuay, D.F.
1980: Michipicoten Area (NTS 41N/NE and part of 41N/NW), Districts of Algoma and Sudbury; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 79, 14 p. Accompanied by Map 5010, scale 1:100 000.

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MAP
(accompanying report)

Map 5010 (coloured) - Northern Ontario Engineering Geology Terrain Study, Data Base Map, Michipicoten (NTS 41N/NE and part of 41N/NW). Scale 1:100 000.

Northern Ontario
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by

D.F. McQuay[1]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Michipicoten area, Districts of Algoma and Sudbury. The area, which covers NTS block 41N/NE and part of 41N/NW, lies between Latitudes 47°30′N and 48°00′N and Longitudes 84°00′W and 85°03′W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5010, accompanying this report).

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[1]Earth Scientist, Gartner Lee Associates Limited, Markham, Ontario.

Manuscript approved for publication by the Chief, Engineering and Terrain Geology Section, January 25, 1980. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

Interpretation of existing black and white aerial photographs, at a scale of approximately 1:54 000, was the primary method of obtaining this terrain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of this terrain data is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

Most of the Michipicoten map-area is underlain by Early Precambrian bedrock which outcrops extensively in the generally rugged terrain. Felsic igneous and metamorphic rocks (including granite, diorite, and gneiss) dominate the eastern two-thirds of the area (Milne *et al.* 1972). Very few mineral occurrences have been noted in these rocks and they generally have a low mineral potential rating (Springer 1977).

Almost all of the area's mineral occurrences are found in two metavolcanic-metasedimentary belts. The more productive of the two, located in the northwest corner of the area, is part of a large belt lying to the north. It contains occurrences of gold, silver, copper, lead, zinc, and iron. Nine past-producing gold mines lie within McMurray Township. The rocks of this belt have high to moderate potential for gold-silver and copper-lead-zinc.

The southern belt, centred in Tiernan and Asselin Townships in the south-western part of the area, contains occurrences of gold, copper, nickel, and molybdenum. This belt has high to moderate potential for nickel-copper mineralization.

2.2 QUATERNARY:

The last glacial advance in this part of northern Ontario was toward the south-southwest. The numerous north- and northeast-trending esker ridges in the Michipicoten map-area are good indicators of ice movement directions during retreat of the ice front. Ground moraine, the most extensive glacial deposit in the area, generally occurs as a thin, discontinuous layer of sandy till overlying the bedrock.

During deglaciation, meltwater from decaying ice masses deposited sand and gravel in glacial spillway channels. In some places these meltwater channels broaden into relatively level outwash plains. Some of these deposits represent good potential sources of sand and gravel, the most promising being located in the north-central and eastern parts of the map-area.

The lower ground along the Lake Superior shore, below an elevation of about 300 m, was inundated toward the end of the Pleistocene by a high-level post-Algonquin glacial lake. As a result, raised beaches of sand and gravel were deposited. However, the high rocky shores along this part of Lake Superior were generally washed bare, and beach materials accumulated in only a few protected areas. These deposits have some potential for sand and gravel, but most are not accessible by main roads.

Since deglaciation alluvial deposits of silty sand and gravel have accumulated along most of the rivers and streams. Organic deposits have accumulated in many depressions within the bedrock terrain and also along poorly drained river valleys.

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK LANDFORMS:

3.1.1 Description:

Rock knob (RN) topography is the dominant terrain unit in the Michipicoten map-area. Rugged bedrock hills are common and often exceeed 60 m in height. Slope conditions are highly variable and steep, adding to the complex nature of the landscape.

Drift cover is shallow and discontinuous, and bedrock outcrops are common. The drift, composed of sandy ground moraine, is usually less than 1 m thick over the tops of the bedrock hills, but may thicken to as much as 3 m on the lower slopes and in valleys, between the hills. The bedrock terrain is generally well drained with the exception of depressions containing organic bogs.

A typical letter code depicting the bedrock terrain is:

$$\frac{\text{RN(tMG)}}{\text{Hj-D}}$$

Rock knobs are the dominant landform and ground moraine is the subordinate feature, occurring as a discontinuous veneer of till over the bedrock. Relief is high and the topography is rugged and jagged. The ground surface is well drained and dry.

A variation of the rock terrain occurs in McMurray and Rabazo Townships in the northwest corner of the map-area. The symbol in this case,

$$\frac{\text{RR(tMG)}}{\text{Mj-D}}$$

indicates a ridged bedrock surface.

3.1.2 Significance:

RESOURCES: In some areas, the rock can probably be used for crushed stone purposes, but detailed evaluations of suitability for aggregate use would be required. Bedrock terrain in the western part of the map-area has moderate to high potential for a variety of metallic minerals (Springer 1977). The appropriate government maps, listed in the references for this report, should be consulted for further details.

Ground water supplies within the bedrock will be limited mainly to fracture zones, faults, and fissures. Thus, the occurrence of aquifers is unpredictable and rock terrain has only poor to fair potential for ground water supplies.

GENERAL CONSTRUCTION: The rugged, irregular, and complex slopes of the bedrock terrain present major constraints for development and construction. Excavations in most instances will require blasting, and material handling in rock cuts and fills will be costly. Foundation bearing conditions should be excellent, but steep slopes put serious constraints on the siting of buildings. Location of transportation routes in the rock terrain is complicated by severe grades, potentially expensive cut-and-fill operations, and adverse horizontal alignments. The shallow soils that occur on the steep bedrock slopes are susceptible to erosion when cleared of vegetation.

WASTE DISPOSAL: Bedrock terrain is generally unsuitable for all types of waste disposal. Development of lagoons or tile fields would require costly rock handling and importation of soil fill. In addition, there is often insufficient cover material available for sanitary landfills.

3.2 MORAINAL LANDFORMS:

3.2.1 Description:

Ground moraine (MG) is widespread throughout the map-area, occurring mainly as a shallow, discontinuous veneer of sandy till overlying the bedrock. Bouldery conditions are common in these shallow overburden deposits.

In a few places, the till appears to completely cover the bedrock and greater depths of overburden materials are expected. The terrain is less rugged in these areas and the topography is usually undulating to rolling. The variable conditions in these units can be attributed to associated subordinate landforms such as rock knob exposures, organic wetlands, and sand and gravel outwash deposits.

A terrain unit letter code typical of the ground moraine in the northeastern part of the map-area is:

$$\frac{\text{tMG/R(RN,pOT)}}{\text{Ln-D(M)}}$$

This indicates that the ground moraine dominates the landscape, but still probably forms a relatively thin mantle over the bedrock. The till is likely variable in depth, but may reach thicknesses of about 5 to 10 m. Rock knobs and organic wetlands occur as subordinate landforms in this terrain unit. The relative relief is generally low, but knobby or hilly conditions are characteristic of the topography. The surface drainage varies from dry to mixed.

3.2.2 Significance:

RESOURCES: The ground moraine units represent potential sources of borrow material for road base and other types of fill construction. Where outwash features are found in association with these units, small deposits of sand and gravel may occur. Because the overburden comprising these landforms is generally thin they probably have low potential for ground water resources.

GENERAL CONSTRUCTION: Variable construction conditions can be expected. However, ground moraine areas generally provide good building sites and route alignments can be located such that topographic limitations are minimized. Excavations may encounter bedrock in some areas and zones of very bouldery soils may create grading problems. Generally, materials should have good qualities for compaction and re-use. Poor drainage and rock outcrops may cause problems in some areas; these should be properly identified in the early stages of planning.

WASTE DISPOSAL: This terrain may provide suitable sites for disposal of waste materials. Detailed investigations of soil types and depth, hydrogeological conditions, and surface drainage should be undertaken to ensure proper site selection for such facilities.

3.3 GLACIOFLUVIAL LANDFORMS:

3.3.1 Description:

Outwash (GO) landforms generally occur as level, well-drained deposits of sand and gravel occupying low areas within the bedrock terrain. These deposits are often variable in texture, ranging from areas that are predominantly sandy to others having high gravel contents. The larger deposits,

particularly those in the northern part of the map-area, contain areas of deep sand and gravel. Some gravel pits and well logs indicate depths exceeding 20 m. Several outwash deposits are associated with esker ridges composed of sand and gravel.

The deposit south of Whitefish Lake, in the north-central part of the area is mapped as:

$$\frac{\text{sgGO}}{\text{Lp-D}}$$

This symbolizes an outwash deposit composed of sand and gravel, but with an overall higher proportion of sand. Relief is low and the ground surface is relatively level. Surface drainage conditions are normally dry. Several pits have been developed in the Whitefish Lake deposit; one pit in particular, located on the Algoma Central Railway, has produced very large quantities of aggregate.

Other symbols indicate complex ground conditions in association with outwash deposits. One example, from the east-central part of the map-area is:

$$\frac{\text{sGO/R(RN,tMG,sAP)}}{\text{Lpu-M}}$$

The outwash is probably sandy in this case and forms a thin veneer over bedrock. Rock knobs, ground moraine, and sandy alluvial plain occur as subordinate landforms. Relief is low, the topography is level to undulating, and drainage conditions are mixed wet and dry.

Eskers (GE) are abundant in the Michipicoten map-area. They occur either as single ridges of sand and gravel or as complex features associated with outwash and having multiple ridged topography. Some of the larger individual ridges may be over 20 m in height and 30 to 40 m wide.

One of the larger esker complexes, located southwest of Anjigami Lake in the western part of the area, is shown as:

$$\frac{\text{sgGE(pOT)}}{\text{Lnr-D(W)}}$$

This indicates that the esker is composed of sand and gravel. Many of the esker deposits in this area are coarse textured, having gravel contents as high as 40 percent. Relief is low and the topography is hummocky and ridged. These conditions have resulted in the formation of organic bogs as a subordinate landform in this unit. The ground surface is mainly dry, but in the vicinity of the organic areas, wet conditions prevail.

3.3.2 Significance:

RESOURCES: Many of the outwash deposits represent good sources of sand and gravel. Gravel pits have been developed at several locations and, in some cases, large volumes of material have been extracted for aggregate use and general construction. The pits at Wawa provide examples of current, moderately large-scale operations. Likewise, eskers often represent excellent sources of sand and gravel; in the Michipicoten map-area, potentially large quantities of granular materials exist in these landforms.

GENERAL CONSTRUCTION: In general, glaciofluvial landforms provide good conditions for construction. Materials excavate and grade easily, and bearing capacities for foundations should be adequate in most cases. Soils should present few problems for road base design, and conditions are generally favourable for the siting of route alignments. Some of the esker complexes, however, might require significant cut-and-fill.

In complexes where shallow outwash is associated with bedrock and other features, construction may have to contend with extra engineering costs for rock handling and dewatering in excavations.

WASTE DISPOSAL: Glaciofluvial landforms do not always provide the best sites for disposal of either solid or liquid waste. Disposal in such areas will have to deal with the potential problem of contamination of both ground and surface waters. This is because glaciofluvial materials can be very permeable, allowing contaminants to migrate easily to nearby streams or to the water table. Careful investigations should be undertaken to determine the impact of waste disposal in glaciofluvial terrain.

3.4 GLACIOLACUSTRINE LANDFORMS:

3.4.1 Description:

Glaciolacustrine deposits are sparse in the Michipicoten map-area and occur only as raised lacustrine beaches adjacent to the present Lake Superior shoreline. The largest of these landforms, located in the south-western part of the area, are confined mainly to lowland areas in the bedrock terrain. Remnants of beach scarps that mark the levels of former glacial lakes are shown by graphic symbols.

The composition of the beach deposits varies from mainly sand in some areas to predominantly cobbly gravel in others. A typical letter code describing these features is:

$$\frac{\text{sgLB}}{\text{Lst-D}}$$

This indicates a lacustrine beach landform that is composed of sand and gravel, probably containing more sand than gravel. Relief is low and the land slopes gently in terraces toward Lake Superior. Surface materials are well drained and dry.

3.4.2 Significance:

RESOURCES: The beaches represent potential sources of sand and gravel for local use. At present they are not accessible by main roads; consequently, only one or two small pits have been opened for forestry roads.

GENERAL CONSTRUCTION: These deposits are generally suitable for construction purposes. The materials excavate and grade easily and foundations can be sited with minimal difficulty. Side slopes in deep cuts can have zones of instability which may require benching and revegetation.

WASTE DISPOSAL: The sandy beach deposits have potentially suitable conditions for the siting of septic tile fields. The permeable materials in these landforms place constraints on the development of sanitary landfills and liquid waste lagoons. Care must be taken to avoid contamination of both surface and ground waters. Subsurface investigations should be undertaken prior to consideration of any type of waste disposal facility.

3.5 ALLUVIAL AND ORGANIC LANDFORMS:

3.5.1 Description:

Alluvial plains (AP) are associated with most of the modern rivers and streams in the Michipicoten map-area. They form the bottomlands of river valleys and are a result of erosion and deposition by the river. Materials in these features are usually sandy to gravelly in texture, but organic deposits have accumulated in some areas. High water table conditions are common in these deposits and they may be susceptible to flooding.

A typical example is the alluvial plain along the Agawa River, depicted by the letter code:

$$\frac{\text{sAP(sGO)}}{\text{Lpc-M}}$$

This indicates that the alluvial plain consists mainly of sand and, in places, is associated with outwash terraces, themselves composed predominantly of sand. Relief is low and the ground surface is level but channeled by the river. Surface drainage conditions are mixed wet and dry.

Patches of *organic terrain* (OT), which are scattered throughout the map-area, occur mainly in poorly drained depressions in the bedrock. They are usually composed of peaty materials; relief is low; the surface is flat; and drainage conditions are often wet.

3.5.2 Significance:

Development on alluvial plains will encounter many problems. Soft ground conditions, poor surface drainage, flooding, and high ground water levels are the main engineering constraints. However, when associated with valley train (outwash) deposits, they often provide the best alternative for locating route alignments. For example, the Agawa River valley forms an integral part of the Algoma Central Railway route. As well, there may be some potential for small scale extraction of granular materials, particularly in valleys containing outwash deposits.

Organic terrain presents many problems for most types of human activity and is generally unsuitable for development. The main problems for construction are the soft and highly compressible soils, flooding conditions, and poor accessibility.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

Most of the map-area is composed of rugged bedrock terrain. The bedrock presents major constraints for all types of development. Areas providing the best conditions for general construction and development include outwash and lacustrine beach landforms. The largest of these are located in the northern part of the map-area. The outwash and beach deposits also represent potential sources of sand and gravel. The best access routes through the bedrock terrain follow the major river valleys.

Table 1 is a summary of the general engineering significance of the more common terrain units found in the area. This table is intended only as a guide to help the reader in assessing the overall significance of the map-units. Site-specific work is necessary to better define actual ground conditions, such as drainage and slope, which are not considered in the table but which may affect the engineering significance of the various terrain units.

TABLE 1: SUMMARY OF ENGINEERING SIGNIFICANCE

		BEDROCK	MORAINAL	GLACIOFLUVIAL		GLACIOLACUSTRINE	ALLUVIAL	ORGANIC
		RN	tMG/R	sgGO	sgGE	sgLB	AP	pOT
RESOURCE POTENTIAL	Sand & Gravel	Poor	Poor	Good	Good	Fair to Good	Fair to Poor	Poor
	Ground Water	Poor	Poor	Good	Fair to Poor	Fair to Good	Fair	Poor
CONSTRUCTION CONDITIONS	Excavation	Blasting	Fair to Poor	Good	Fair to Good	Fair to Good	Poor	Poor
	Foundation	Excellent	Good	Good	Fair to Good	Fair to Good	Poor	Poor
	Grading	Difficult	Fair	Good	Good	Good	Fair	Poor
	Material Re-Use	Rockfill	Fair	Good	Good	Good	Fair	Poor
WASTE DISPOSAL SUITABILITY	Septic Systems	Very Poor	Fair	Good	Fair to Poor	Good	Poor	Poor
	Landfill	Poor	Fair to Poor	Fair to Poor	Poor	Fair to Poor	Poor	Poor
	Lagoons	Poor	Fair to Poor	Fair to Poor	Poor	Poor	Poor	Poor

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